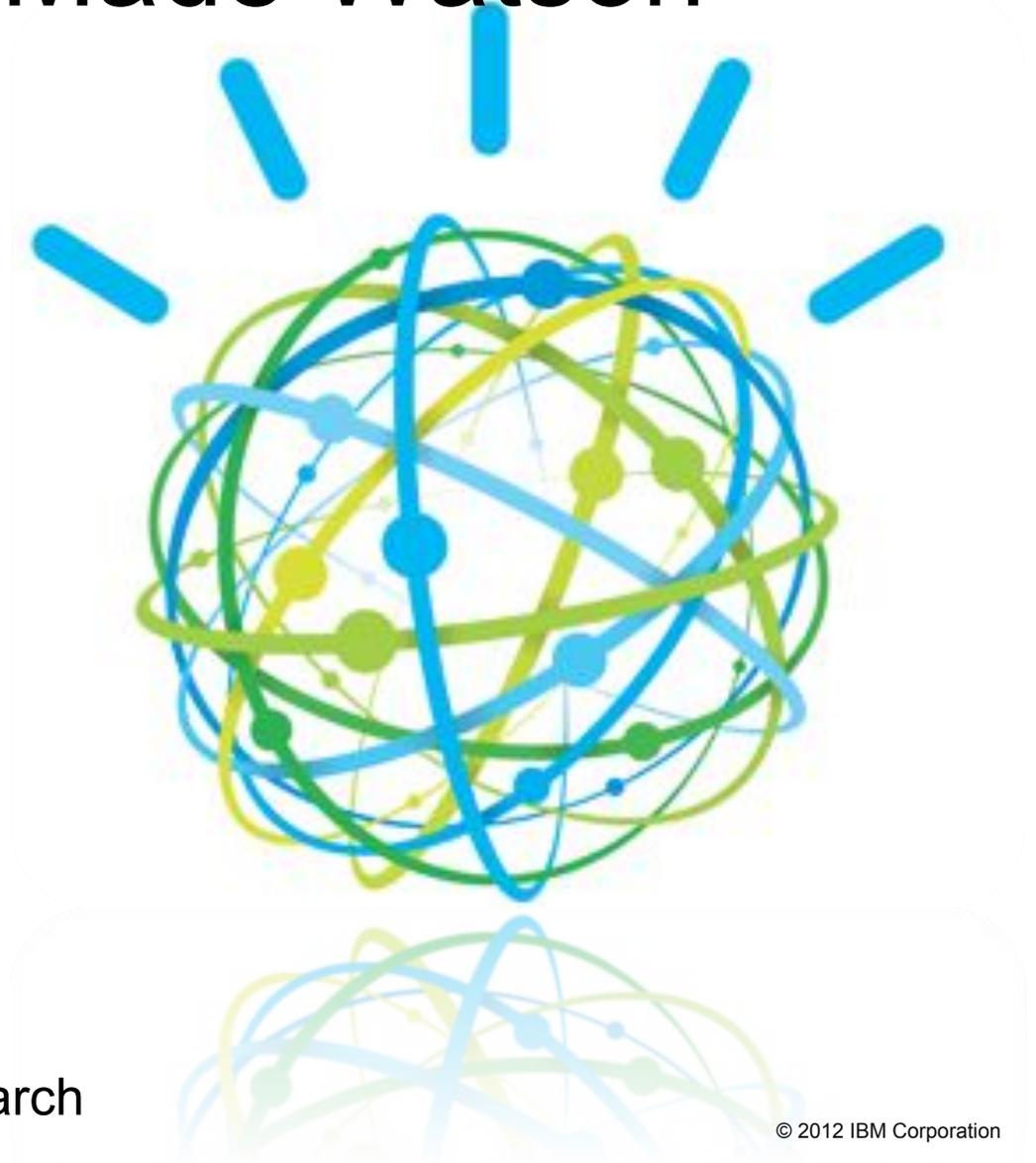


This Research Made Watson Possible



Eric Brown, PhD
Research Scientist
Watson Technologies, IBM Research

Want to Play Chess or Just Chat?

■ Chess

- A finite, mathematically well-defined search space
- Limited number of moves and states
- All the symbols are completely grounded in the mathematical rules of the game



■ Human Language

- Words by themselves have no meaning
- Only grounded in **human cognition**
- Words navigate, align and communicate an infinite space of intended meaning
- Computers can **not** ground words to human experiences to derive meaning



Hard Questions or Hard Answers or both? Depends on the Evidence.

Person	Birth Place
A. Einstein	ULM

Structured

Unstructured

■ Where was X born?

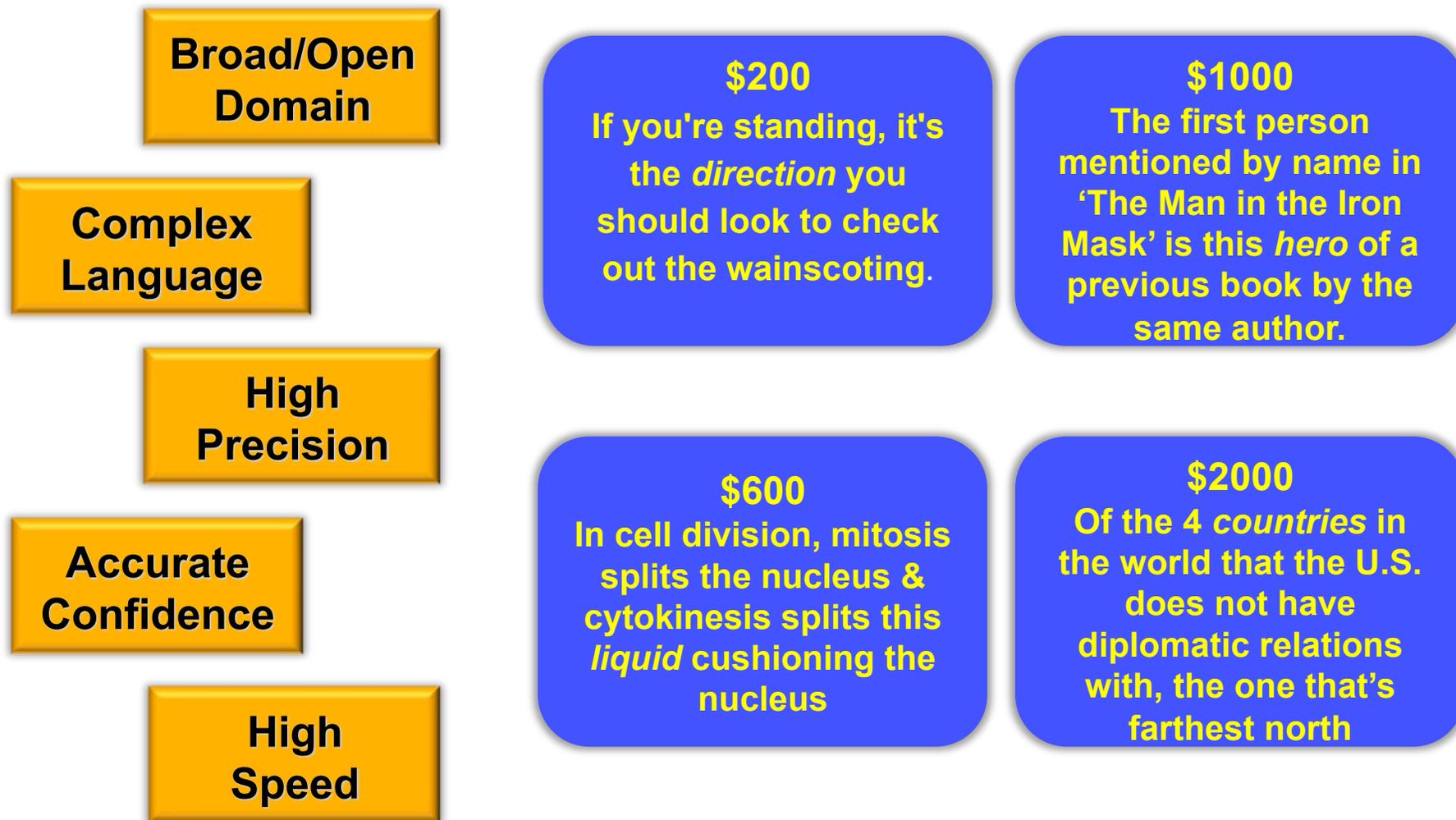
One day, from among his city views of Ulm, Otto chose a water color to send to Albert Einstein as a remembrance of Einstein's birthplace.

Person	Organization
J. Welch	GE

■ X ran this?

If leadership is an art then surely Jack Welch has proved himself a master painter during his tenure at GE.

The Jeopardy! Challenge: A compelling and notable way to **drive** and **measure** the technology of automatic Question Answering along 5 Key Dimensions



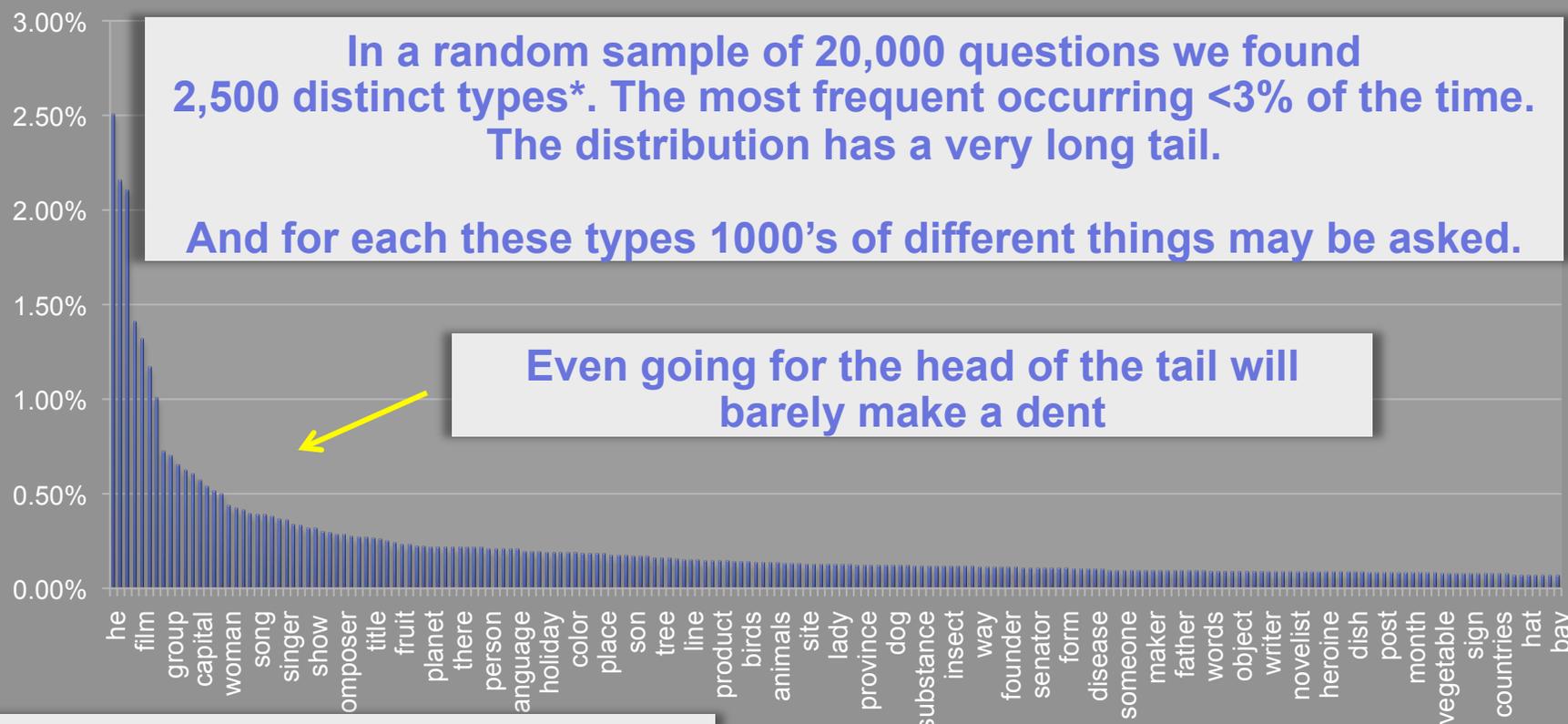
Broad Domain

We do NOT attempt to anticipate all questions and build specialized databases.

In a random sample of 20,000 questions we found 2,500 distinct types*. The most frequent occurring <3% of the time. The distribution has a very long tail.

And for each these types 1000's of different things may be asked.

Even going for the head of the tail will barely make a dent



*13% are non-distinct (e.g., it, this, these or NA)

Our Focus is on reusable NLP technology for analyzing volumes of *as-is* text. Structured sources (DBs and KBs) are used to help interpret the text.

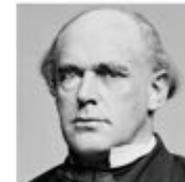


RESIGNATION?

LINCOLN BLOGS
TREASURY SECY. CHASE
JUST SUBMITTED THIS
TO ME FOR THE THIRD
TIME — GUESS WHAT,
PAL. THIS TIME I'M
ACCEPTING IT

FRIEND REQUEST?

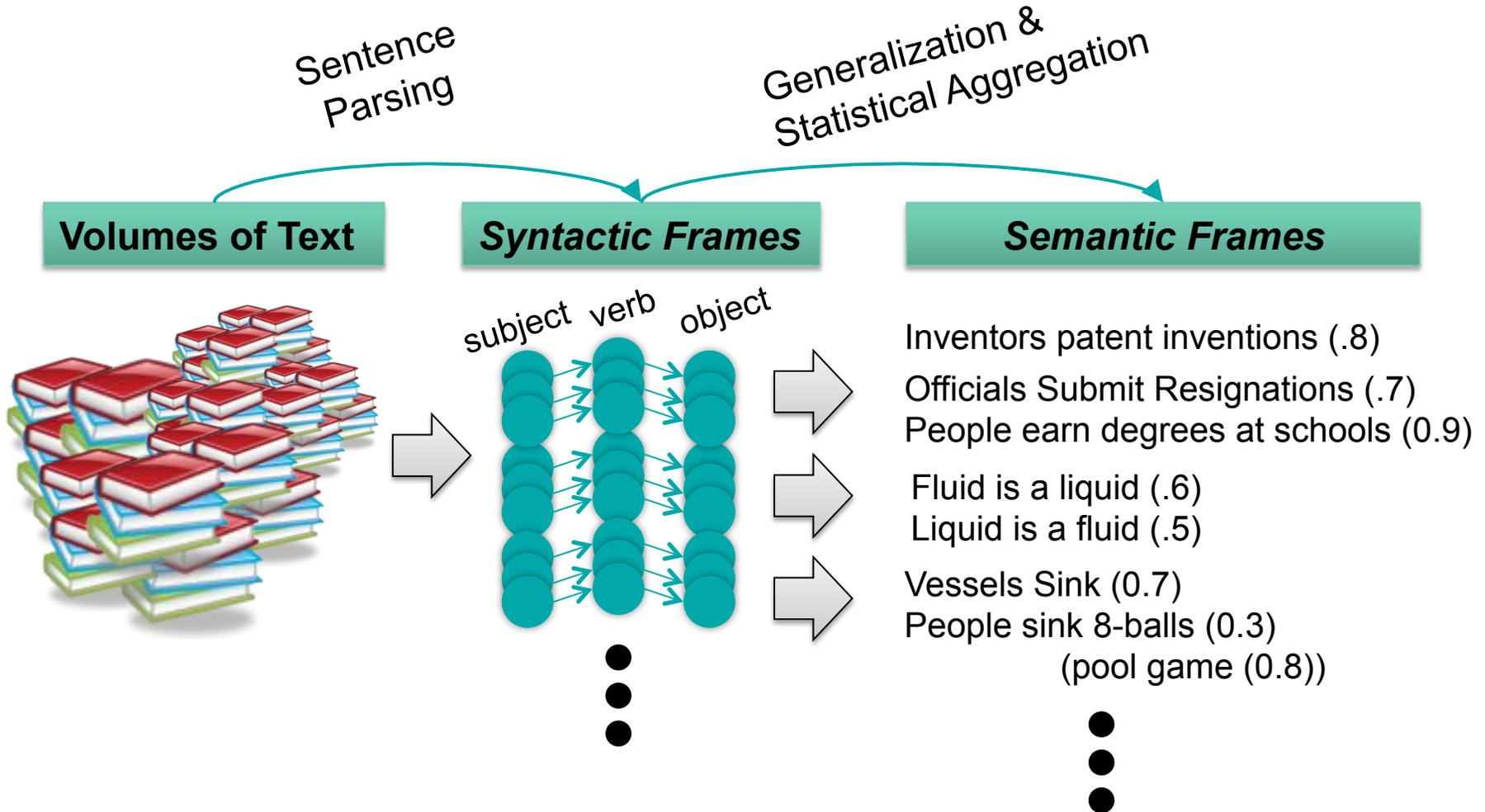
Treasury Secy. Chase wants to be friends with you.



Treasury Secy. Chase
279 friends · 52 photos · 21 groups

Confirm Friend Request

Inducing Meaning



Generating Possibilities, Gathering and Scoring Evidence

In cell division, mitosis splits the nucleus & cytokinesis splits this **liquid** cushioning the nucleus.

- *Organelle*
- *Vacuole*
- *Cytoplasm*
- *Plasma*
- *Mitochondria*
- *Blood ...*

- Many candidate answers (CAs) are generated from many different searches
- Each possibility is evaluated according to **different dimensions of evidence**.
- **Just One** piece of evidence is if the CA is of the right type. In this case a “liquid”.

Is(“Cytoplasm”, “liquid”) = 0.2↑
 Is(“organelle”, “liquid”) = 0.1
 Is(“vacuole”, “liquid”) = 0.2
 Is(“plasma”, “liquid”) = 0.7

“Cytoplasm is a **fluid** surrounding the nucleus...”

Wordnet → Is_a(Fluid, Liquid) → ?

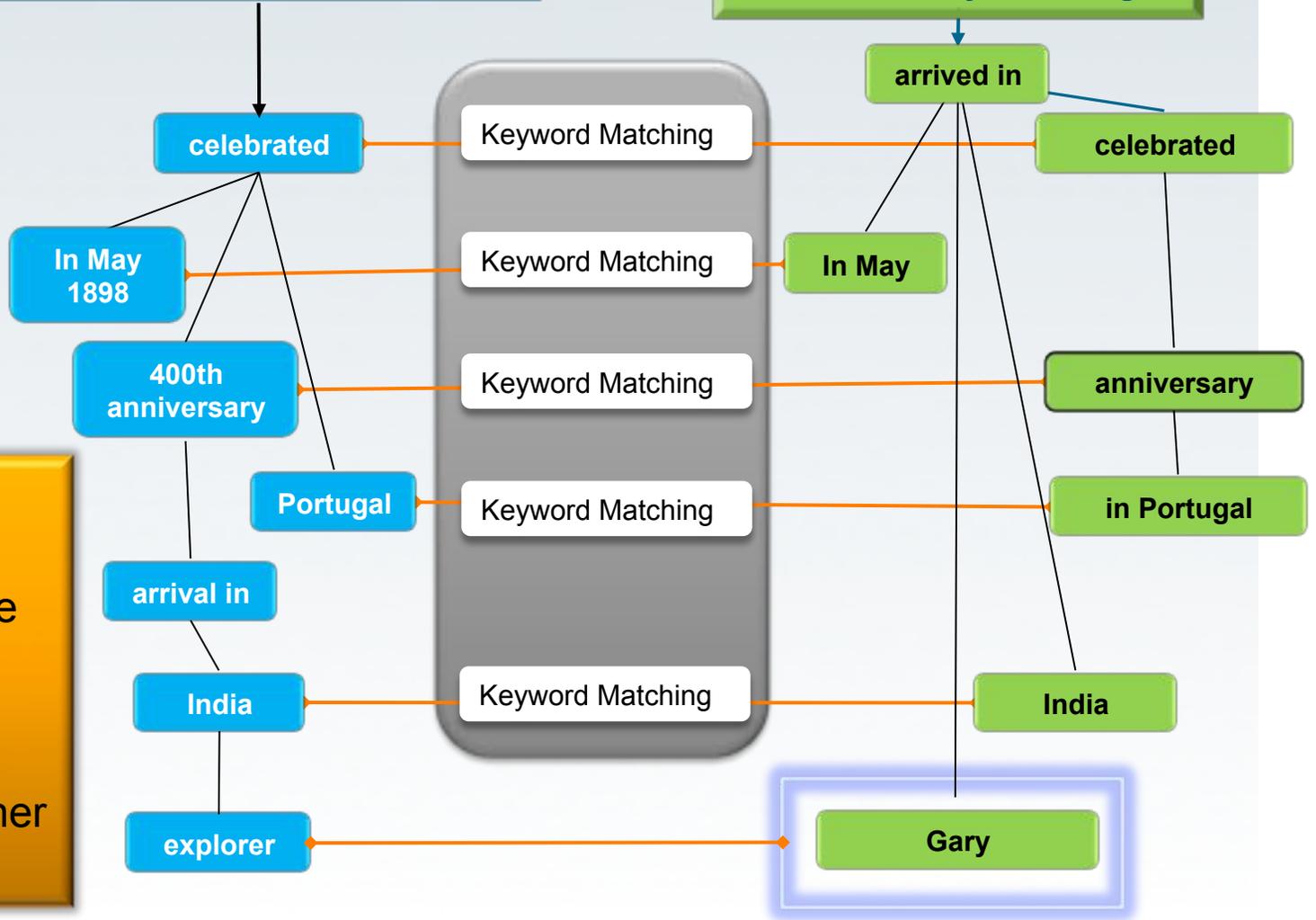
Learned → Is_a(Fluid, Liquid) → yes.

Quality of Evidence: Weak Evidence



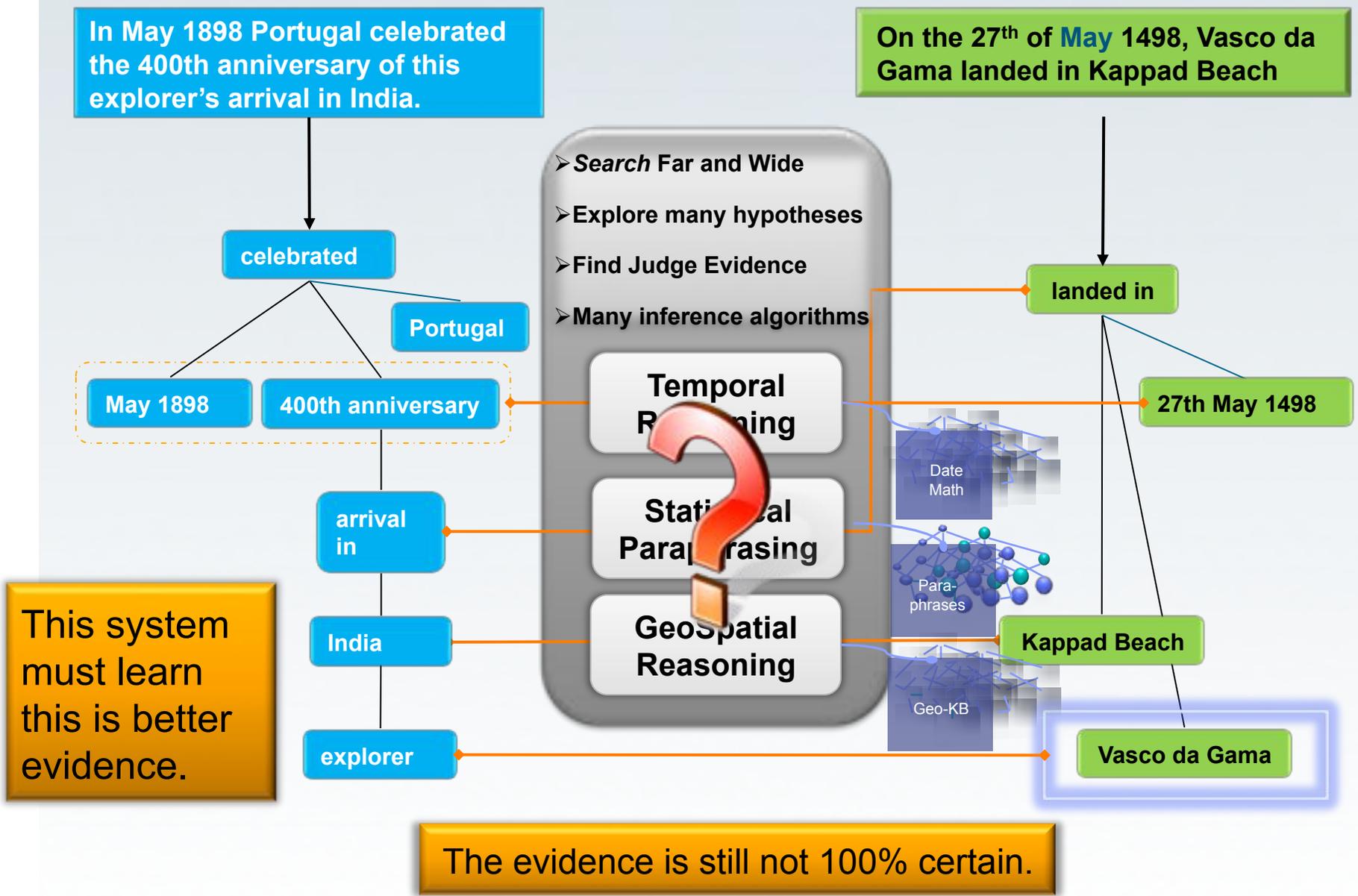
In May 1898 Portugal celebrated the 400th anniversary of this explorer's arrival in India.

In May, Gary arrived in India after he celebrated his anniversary in Portugal.



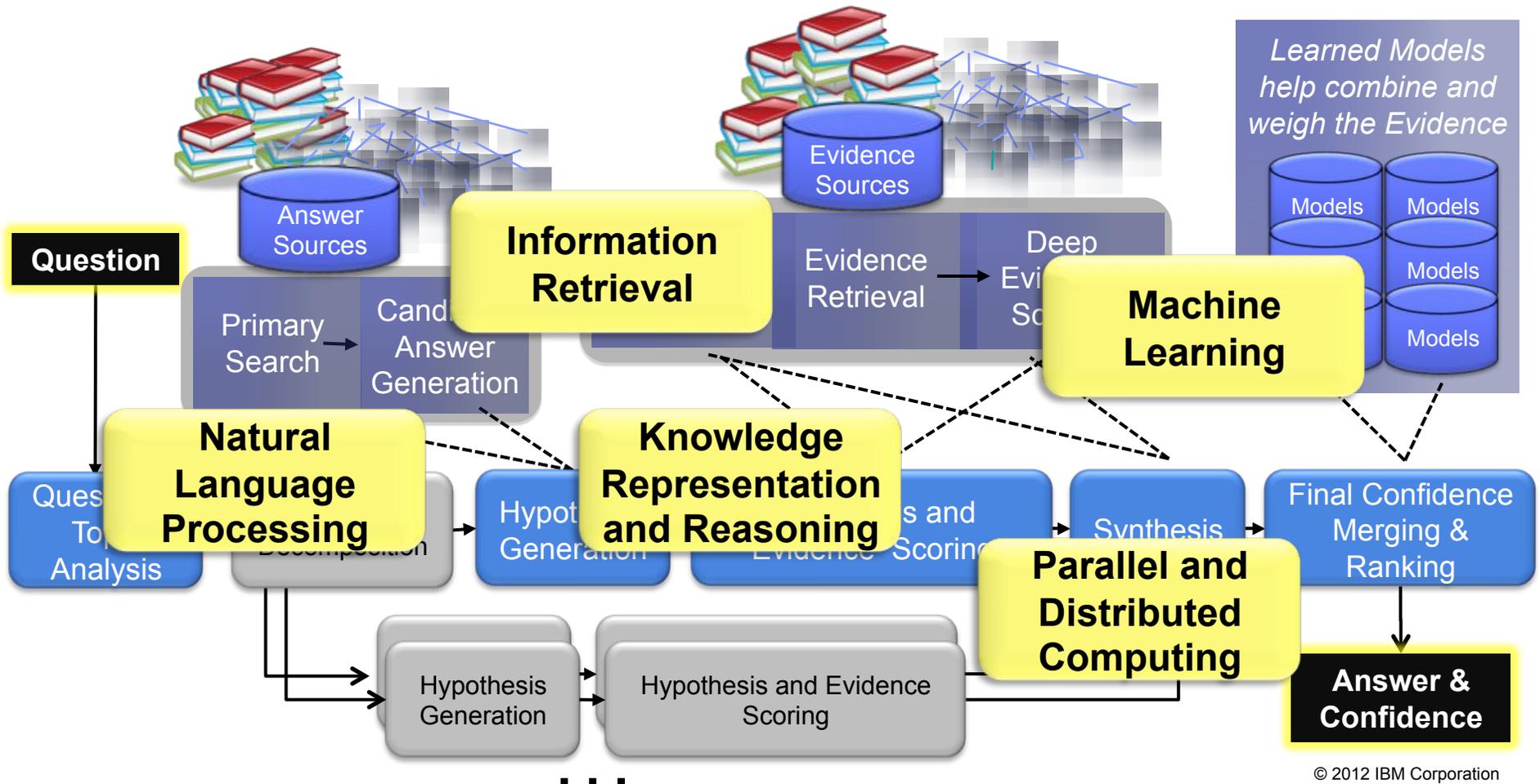
This evidence suggests "Gary" is the answer BUT the system must learn that keyword matching may be weak relative to other types of evidence

Quality of Evidence: Better Evidence



DeepQA: The architecture underlying Inside Watson

*Generates many hypotheses, **collects a wide range of evidence** and balances the combined confidences of **over 100 different analytics** that analyze the evidence form **different dimensions***



The team that built Watson



With Precision, Accurate Confidence and Speed, the rest was History



Potential Business Applications



Healthcare / Life Sciences: Diagnostic Assistance, Evidenced-Based, Collaborative Medicine

Tech Support: Help-desk, Contact Centers



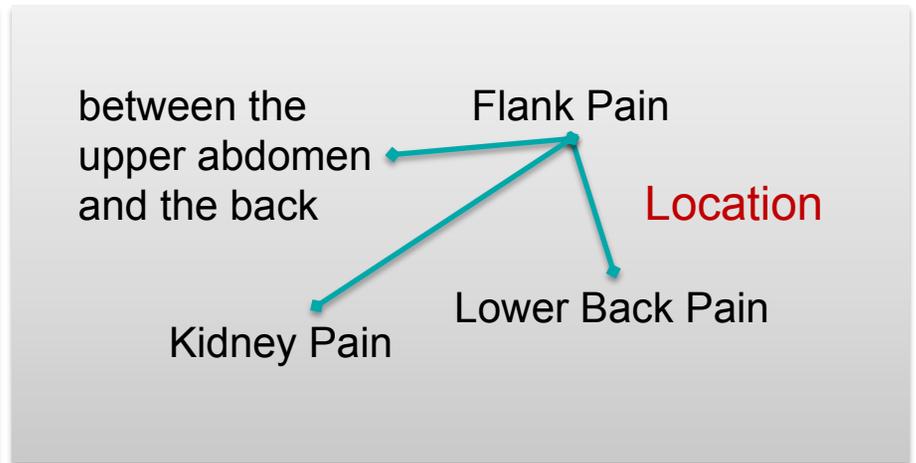
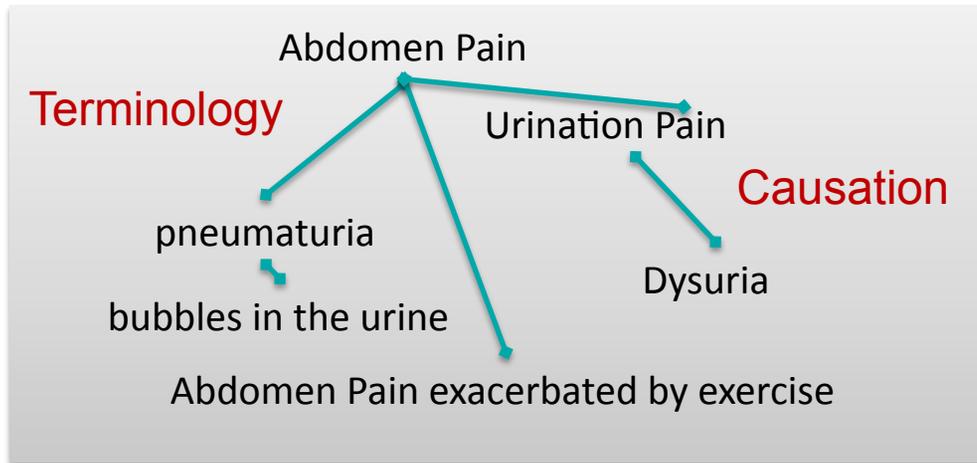
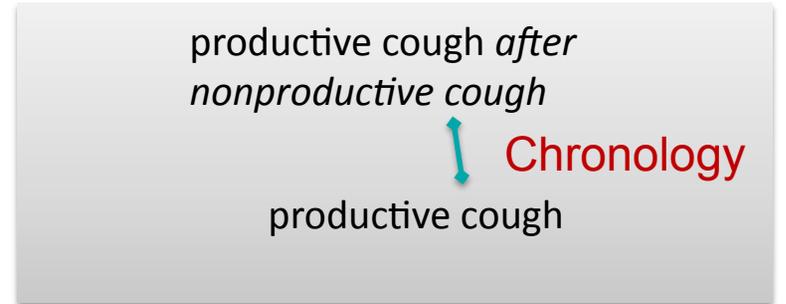
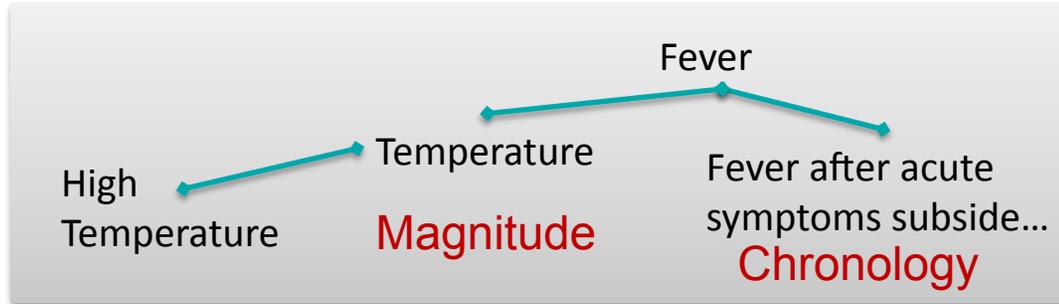
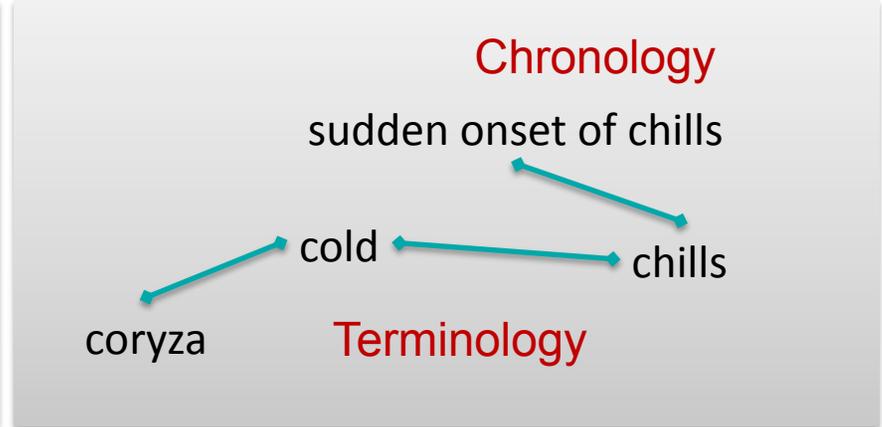
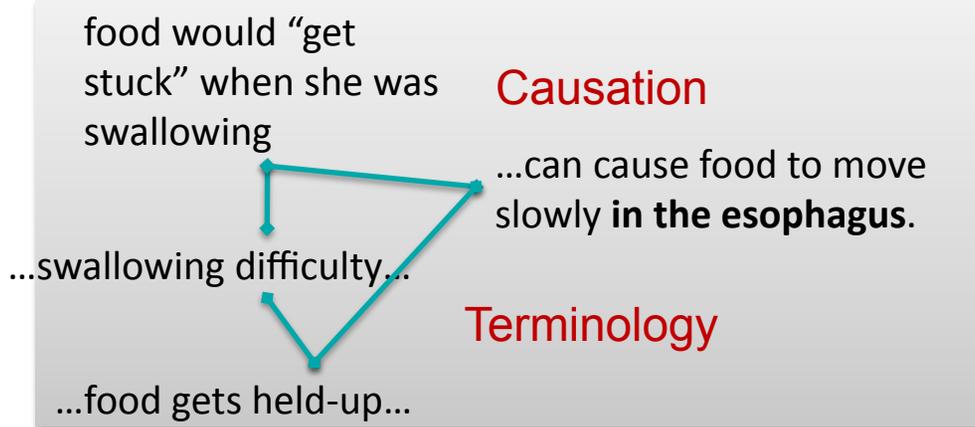
Enterprise Knowledge Management and Business Intelligence

Government: Improved Information Sharing and Security



Meaning and Expression in Healthcare

(many different expressions, meaning highly dependent on context)

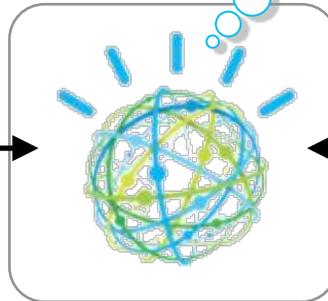


Teach Watson -- technology generates questions to enhance understanding and acquire new knowledge – used in dialog or crowd-sourcing opportunities

Watson considers...

What would have to be true for *seizure disorder* to be correct?

What neurological condition **contraindicates the use of** bupropion?

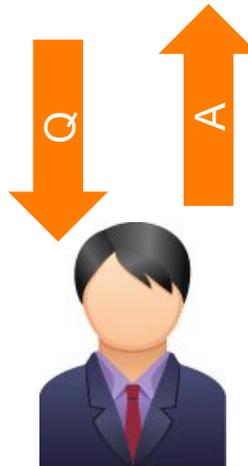


Patients with preexisting *seizure disorder* **should not use** bupropion due to a higher-than-proportional increase in the possibility of seizure as the dose is increased.

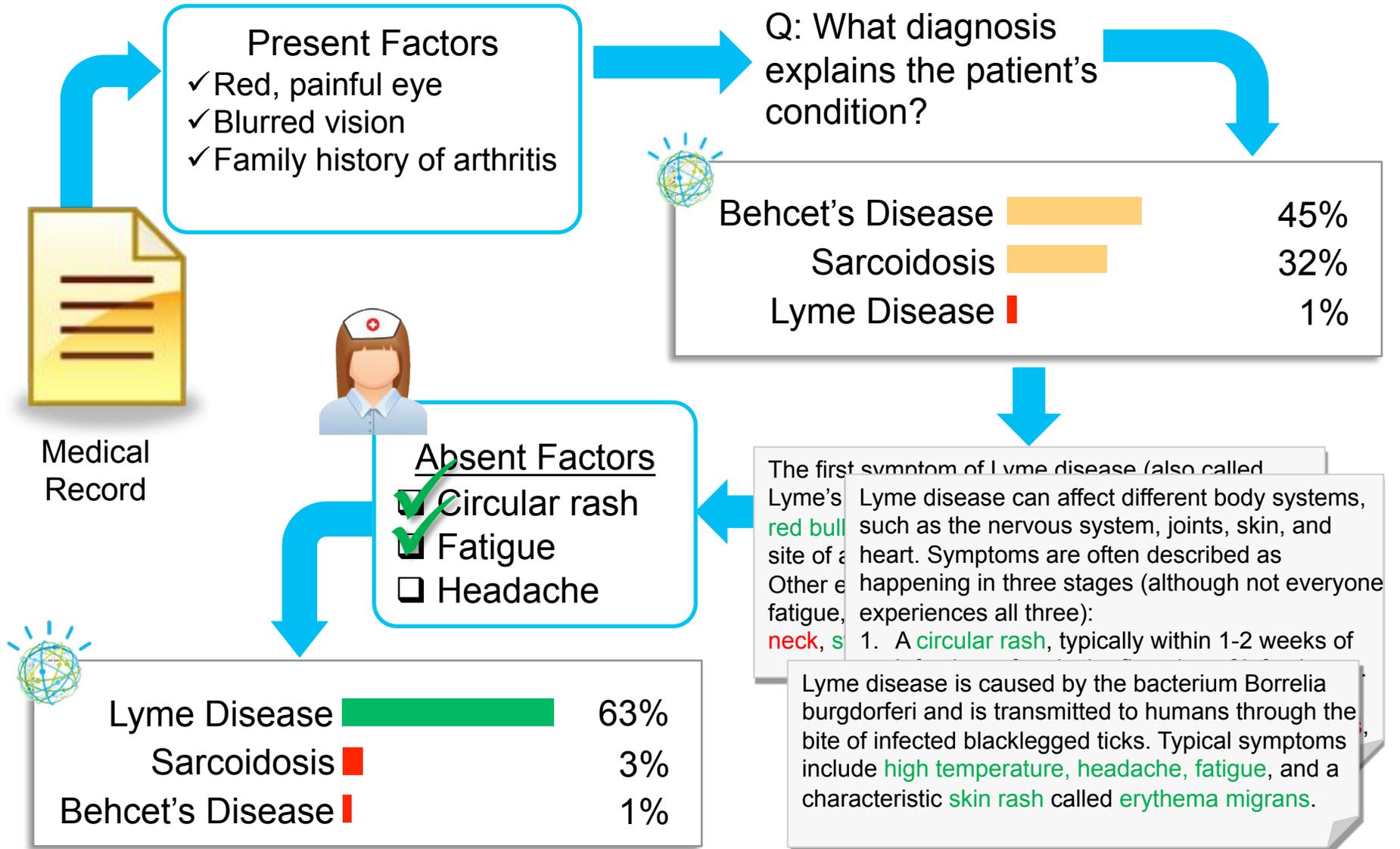
Automatically generates Learning Questions...

Does *contraindicates the use of bupropion* mean **should not use** bupropion?

Does “**contraindicates the use of**” mean “**should not use**” in general?



Dialoguing to an answer



It's all about the evidence

Symptoms
Family History
Demographics

Samantha Darren

Evidence Profile: Diagnosis

Quality	80%
Cost	48%
Relevance	42%

Symptoms	Family History	Demographics
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Sources
Factors

Present Factors

<input type="checkbox"/>	Red eye
<input type="checkbox"/>	Eye pain
<input type="checkbox"/>	Eye inflammation
<input type="checkbox"/>	Blurred vision
<input type="checkbox"/>	Floating spots
<input type="checkbox"/>	Sensitivity to light

Absent Factors

<input type="checkbox"/>	Patient has low visibility
<input type="checkbox"/>	Patient has loss of hearing
<input type="checkbox"/>	Patient wears prescription lenses
<input type="checkbox"/>	Patient has yellow eyes
<input type="checkbox"/>	Patient has puss in eyes
<input type="checkbox"/>	Patient is allergic to pollen

Sources
Factors

Textbook
uvulitis specifically refers to **inflammation** of the middle layer of the eye, termed the "uvula" but in common usage may refer to any inflammatory process involving the interior of the eye.

Website
uvulitis usually develops quickly and generally affects only one eye. Signs and symptoms may include any or all of the following: **pain in the eye** or brow region, worsened eye **pain when exposed to bright light**, and **reddened eye**, especially adjacent to the iris.

Medical Journal
 The most common form of *uvulitis* is anterior *uvulitis*, which involves **inflammation** in the front part of the eye. It is often called **iritis** because it usually only affects the iris, the colored part of the eye.

Textbook
uvulitis is often marked by moderate to intense **pain** and usually involves **impaired eyesight**.

THANK YOU